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Conscious and unconscious processes in human desire

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Abstract

Elaborated Intrusion theory (Kavanagh, Andrade & May 2005) distinguishes between unconscious, associative processes as the precursors of desire, and controlled processes of cognitive elaboration that lead to conscious sensory images of the target of desire and associated affect. We argue that these mental images play a key role in motivating human behavior. Consciousness is functional in that it allows competing goals to be compared and evaluated. The role of effortful cognitive processes in desire helps to explain the different time courses of craving and physiological withdrawal.

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We define desire as a conscious state, distinguishing it from underlying neural mechanisms of reward and from physiological drug withdrawal symptoms. Desire is a complex mixture of images, thoughts, and expectations combined with positive and negative emotions. It is a felt need or want, a "subjectively experienced motivational state, which fluctuates over time" (Field, Munafò & Franken, in press). We contend that all desires include both pleasure, which comes from thinking about the target of desire, and distress from the absence of the target. The balance of positive and negative feelings varies, from the mainly pleasurable anticipation of satisfaction on entering a restaurant when hungry, to the agonizing craving in the face of prolonged deficit when a person with high physical dependence stops using an addictive drug. Although the term "craving" is usually reserved for intense urges in addictions, the phenomenology of cravings and desires is similar across a range of addictive and everyday substances and activities, from smoking tobacco and drinking alcohol to eating food and playing sport (e.g., May, Andrade, Kavanagh & Penfound, 2008). We therefore use the term "desire" to refer to desires for addictive drugs as well as more mundane wants, reserving "craving" for discussing findings emanating specifically from the literature on drug addiction.

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We argue that the precursors of desire are usually unconscious. Self-report data show that people rarely have insight into the negative moods, physiological changes, or environmental stimuli that trigger their desires (May, Andrade, Panabokke & Kavanagh, 2004). Desire itself involves conscious cognition and felt emotions. In this paper we present the Elaborated Intrusion theory of desire (EI theory; Kavanagh, Andrade & May, 2005; May et al., 2004), which explains the different roles of conscious and unconscious cognitive and emotional processes in desire. We argue that distinguishing between conscious and unconscious processes allows us to explain several important features of desire: its role as a motivator of behavior, its temporal dynamics, and its vulnerability to interference.

Existing models of desire explain how drug addiction involves changes in the brain's reward pathways, such that drug cues become more rewarding and more noticeable (Franken, 2003; Robinson & Berridge, 1993). They explain how learned associations between specific environments and the effects of drugs or drug withdrawal can trigger craving (e.g., Stewart, de Wit, & Eikelboom, 1984; Wikler, 1973). They also explain how people's expectations about drug effects and confidence in their self-control determine whether they act out their desires (e.g., Bandura, 1999). These models explain some important features of craving and addiction, including the fact that people find it easier to quit addictions in novel environments, which they have not previously associated with drug use (Robins, Helzer & Davis, 1975) and the fact that cravings increase as addictions progress, even though addicts report liking the drug less (Robinson & Berridge, 1993). None of the theories explains well the variability of desire depending on competing cognitive tasks or the relative independence of desire and physiological withdrawal symptoms. Desire for drugs can lessen while physiological symptoms increase, for instance in the first few days after stopping smoking (Shiffman et al., 1997), and remain high after physiological symptoms have normalized (Nava, Caldiroli, Premi, & Lucchini, 2006). Ex-smokers can report a sudden return of cravings for cigarettes months or years after quitting. The same level of physiological hunger can lead to a strong desire to eat while we are engaged in a dull task but pass unnoticed if we are taking a test or giving a talk.

Elaborated Intrusion theory

EI theory (Kavanagh et al., 2005; May et al., 2004) maps out the cognitive and emotional processes active during desire. It gives a key role in desire to mental imagery, the maintenance in consciousness of sensory representations with affective content. Imagery is closely linked with emotion (Holmes, Geddes, Colom & Goodwin, 2008; Holmes & Mathews, 2005): We imagine tragedy and we feel sad, we bring to mind a happy memory and we feel that happiness again. We imagine unwrapping a bar of chocolate and feel the anticipated pleasure of eating it. It is the importance given to imagery that particularly distinguishes EI theory from the other major cognitive theory of desire (Tiffany 1990). In Tiffany's theory, desire is what we feel when we exert cognitive effort to inhibit habitual drug-use behaviors, such as taking a cigarette out of a packet and lighting it. It is an epiphenomenon, whereas in EI theory, desire is a determinant of behavior because it is the means by which we hold emotionally-charged goals in consciousness.

EI theory distinguishes between unconscious, associative processes and controlled processes of cognitive elaboration (Figure 1). Episodes of desire are triggered by a range of environmental, physiological or cognitive cues that increase the likelihood of thoughts about the desired activity breaking into consciousness. Desire is the state that pertains when such thoughts are elaborated, that is, when they lead to ruminations about how to achieve the desire or how to inhibit it, and, importantly, to the construction of conscious, sensory images. People

imagine smoking a cigarette and the pleasure or relief that it will give them, or they imagine playing sport and the pleasure of running fast, winning a competition, et cetera (e.g. May et al., 2008). Desire images are an example of "hot cognition"; they have affective content. We feel pleasure or relief when we imagine consummating our desires. Because the images simulate the desired activity, they are immediately pleasurable. In the longer term, however, they enhance awareness of deficit, the realization that we are trying to quit smoking or have to wait until tomorrow's sporting fixture. This pleasurable imagery and enhanced awareness of deficit lead to a downward spiral of increasingly vivid imagery of the desired activity and worsening mood. The desire becomes stronger as more vivid, briefly pleasurable images are generated in an attempt to rectify the negative mood that they ultimately provoke.

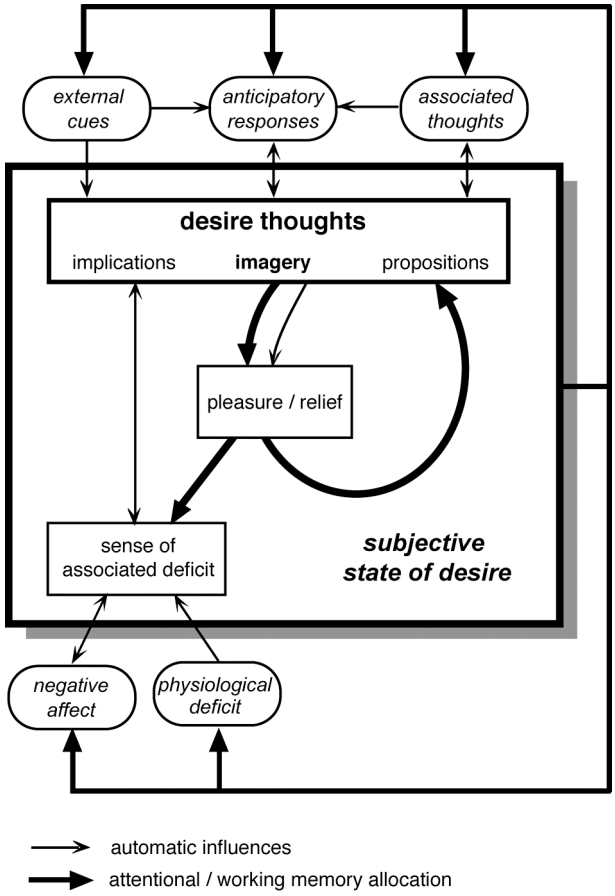

Figure 1. The Elaborated Intrusion theory of desire. The central square box represents desire, rounded external boxes the antecedents of desire. Thick arrows show the controlled processing cycle of conscious imagery and associated affect; thin arrows represent unconscious influences on desire (reprinted from Kavanagh et al., 2005, with permission)

Empirical Support for Unconscious and Conscious Processes in Desire

Self-report data support the distinction between unconscious precursors of craving and conscious imagery, showing that people lack insight into the causes of their craving and experience the start of their craving as an intrusive thought, for example "I'm hungry", "I need a cigarette" (May et al., 2008). Even in an addicted sample, these thoughts often vanish without being elaborated (Kavanagh et al., 2009). Experimental evidence shows that abstinence leads to faster responses to desire-related words relative to neutral words. We found that hungry participants responded more quickly to food-related words (e.g., lunch, crisps) than to transport-related words (e.g., taxi, jet), and that this speeding of response to food words corresponded to the higher incidence of intrusive thoughts about food in hungry, rather than satiated, participants (Berry, Andrade & May, 2007). This evidence supports the assumed relationship between intrusive thoughts and unconscious precursors that increase availability of desire-related information.

The hypothesis of a specific role for mental imagery is supported by self-reports that imagery is a central feature of desire and predictor of desire strength (Kavanagh et al., 2009; May et al., 2008) and through experimental studies that show that selectively blocking the cognitive processes needed for imagery leads to reduced desire (Kemps & Tiggemann, 2007; Panabokke 2004; Versland & Rosenberg, 2007). For example, asking people who are craving a cigarette to imagine neutral visual scenes reduces the strength of their craving compared with asking them to imagine neutral sounds (Panabokke, 2004). The assumption is that auditory and visual imagery systems have limited capacity, so people can imagine sounds at the same time as picturing themselves smoking a cigarette, but they cannot hold two visual images, one of smoking and another of a neutral scene, in mind at the same time. Asking someone to imagine a neutral scene therefore blocks their imagery of a desired activity. Because this imagery is central to desire, blocking it weakens the desire. This finding that we can interrupt desire by asking people to perform specific cognitive tasks is important theoretically, because it shows that desire can vary independently of physiological withdrawal or environmental conditions. Existing neurobiological theories of addiction cannot explain this finding.

Properties of unconscious and conscious processes in desire

Berridge & Robinson (2003) have argued that unconscious and conscious processes in desire are based in different but interlinked brain systems, and use quote marks to differentiate unconscious "wanting" and "liking" from their conscious equivalents. Unconscious "wanting" of a drug is based in dopaminergic reward pathways that are linked to conscious goal-directed planning and desire through cortical pathways. Opioid pathways underpinning the unconscious "liking" for drug effects link to prefrontal cortical pathways involved in the conscious experience of pleasure (Berridge, 2003). In addiction, the unconscious "wanting" pathways become sensitized to drug cues, but the "liking" pathways are attenuated as dose tolerance increases, explaining why drug addicts experience increasingly strong craving for drugs yet get diminished pleasure from their use.

In EI theory, conscious mental imagery of a desired activity triggers immediate feelings of pleasure or relief. We predict that this experience entails activation of the unconscious "liking" pathways as well as cortically-based emotional circuits. Vivid imagery is also predicted to activate unconscious "wanting" circuits and we assume that the conscious, cortical interpretation of this activation elicits the enhanced "sense of deficit" shown in Figure 1. We also predict that the interaction is two-way, with activation of unconscious "wanting" circuits stimulating imagery, and desire generally, via projections to prefrontal cortex. Preliminary support for distinct roles of liking and wanting comes from a qualitative study of people who had recovered from eating disorders. They reported feeling hungry, but not craving food: They "wanted" food, but didn't "like" it and thus, did not crave it by elaborating thoughts about food. Instead, when physiologically hungry, they consciously thought about the positive aspects of being in control of their food intake, and of not putting on weight. They were "wanting" food but "liking" the self-control associated with not eating (Blackburn, 2006).

Brain imaging research supports a role for elaboration in desire, showing an association between drug craving and activation in cortical regions implicated in memory retrieval and imagery (Wang et al., 2007). Orbitofrontal activation may reflect intrusive thoughts (Grant et al., 1996) or attempts to control them; this region has also recently been associated directly with desire (Kawabata & Zeki, 2008). The prediction that brain regions underpinning visuospatial working memory play a key role in desire needs further testing. Also important is to identify the neural pathways by which cognitive elaboration affects

emotion, and to map the timecourse by which initial pleasure or relief afforded by the image turns into the unpleasant sensation of wanting.

Unconscious precursors and conscious desire have different cognitive properties, roughly mapping onto Shiffrin and Schneider's (1977) distinction between fast, parallel automatic processes based in long-term memory systems and slow, effortful but flexible controlled processes requiring working memory. In conscious desire, the cycle of pleasurable imagery followed by enhanced sense of deficit and worsening affect sucks in cognitive resources to support increasing vivid, life-like imagery. Desire thus imposes a cognitive load (e.g., Kemps, Tiggemann & Grigg, 2008) and is interruptible by tasks competing for the working memory processes needed for memory retrieval and image generation and maintenance (Kemps & Tiggemann, 2007; Panabokke, 2004; Versland & Rosenberg, 2007). The assumption of parallel pathways to desire is supported by findings that the effects of unconscious precursors of craving can be additive, for example, negative mood can exacerbate the effects of cocaine withdrawal (Robbins, Ehrman, Childress, Cornish, & O'Brien, 2000).

Enabling conditions of conscious desire

Conscious desires are enabled by bottom-up and top-down processes. Desire requires knowledge or prior experience: We cannot desire something unless we know something about its likely sensory impact. Someone trying heroin for the first time might crave novelty, excitement, or peer approval, but not heroin itself. The unconscious precursors such as physiological effects of deprivation, negative mood, or environmental cues, enable desire in a probabilistic manner, their effects being tempered by top-down processes. For instance, sensitization of dopaminergic reward pathways manifests at a cognitive level as attentional biases to drug-related cues (Franken, 2003). These attentional biases operate outside of cognitive control but serve to direct controlled attention towards drug-cues, thus increasing the probability of a conscious drug-related thought and subsequent elaboration and desire.

Why is this initial drug-related thought conscious? One possibility is that consciousness of this thought occurs because activation of the precursors of desire reaches a threshold. Up until this point, the thought was activated, but not sufficiently so for it to become conscious or enter consciousness. This view invites the criticism of Cartesian materialism (Dennett, 1991), the idea that consciousness is a place or specific event that is somehow "witnessed" by a mind's eye. It is compatible though with a global workspace view (Baars, 1997) whereby the winner of unconscious competition between modular processes escapes its modular existence and becomes globally accessible. Thus the content of unconscious reward processes becomes available for elaboration in working memory. An alternative possibility is that the intrusive thought has properties that are quite different from those of the processes that triggered it. Perhaps we become conscious of our motivation at the point where it becomes self-referential and intentional, in other words when a general sense of wanting is transformed, through the operation of top-down interpretative processes, into the knowledge that "I need a cigarette."

Top-down processes modify the effects of bottom-up precursors of desire. Competing cognitive demands, particularly visuospatial and executive working memory demands, can prevent the elaboration of an intrusive thought into desire. Elaboration can also be modified by competing desires, as in the case of people with anorexia who crave control and thinness when they are hungry, rather than food (Blackburn, 2006). Furthermore, whether these precursors result in indulgence of the desire depends on expectations about the effects of satisfying the desire ("a drink would make me feel great" versus "a drink will destroy my liver"), competing goals ("I need to drive home safely"), and perceived self-efficacy ("I know

I can abstain"). Simply deciding to ignore intrusive thoughts about snack food led to lower consumption, in a recent study by Achtziger, Gollwitzer and Sheeran (2008), an effect possibly mediated by reduced craving.

The influence of top-down processes raises the important point that desires are time-limited. It is the top-down processes that can put an end to desire. Not only can competing cognitive demands prevent an episode of desire beginning, they can also weaken or interrupt a desire that is already established, as shown by the effects of competing tasks on craving in the laboratory. This finding is important clinically: Selective cognitive blockade of the controlled processes needed for desire can potentially reduce craving to the point where it is tolerable, helping to sustain quit attempts. Competing goals may become more urgent, drawing cognitive resources away from the desire ("I really want a cup of coffee but if I don't finish my essay soon I'll miss the next episode of the Wire").

Key questions about desire

A goal for future empirical research is to map the relationship between the controlled cognitive processes that sustain conscious desire and the automatic precursors of desire. In EI theory, we assume that imagery of the desired activity is intrinsically rewarding but has aversive consequences, increasing our sense of deprivation. We predict that conscious imagery of a desired outcome will be associated with activation of opioid "liking" pathways and will trigger increased activity in dopaminergic "wanting" pathways. This prediction, and the predicted time-course of briefly positive affect followed by increasingly negative affect, has yet to be tested.

The obvious philosophical question is "why is desire conscious?" In EI theory, desire has a functional role in motivating behavior. It is the means by which a goal (drug acquisition, for instance) is maintained in working memory and imbued with emotional qualities that mark its salience (through rewarding desire-related imagery and consequently enhanced negative affect). Conscious desire could be epiphenomenal. It is conceivable that a zombie could show the same behavioral sensitivity to competing goals and task demands as we do, but without experiencing the "imaginary relish and exquisite torture" that we know as desire (Kavanagh et al., 2005, p. 1). However, we argue that, in humans, conscious desire plays a functional role that is distinct from that of the unconscious antecedents of desire.

Unconscious processes might lead to automatic, habitual behaviors when there is only one strong response option available (*q.v.* Tiffany, 1990), and the target can be acquired with that simple behavioral response. The process is more likely to remain unconscious when the person is distracted by other cognitive demands, for example, reaching for a cigarette while dealing with a difficult telephone conversation. Without this distraction, the response tends to be tracked, and both the desire and the target acquisition are consciously accessed. Conscious awareness of desires becomes critical when achieving the desire requires more complex behavior chains and when salient goals conflict. The fact that they are conscious allows directed search and manipulation in working memory. Retention in working memory allows a comparison of the relative benefits and costs of the competing targets, and of options for satisfying competing desires. Plans can be developed that minimize effort, risk and delay in acquisition, and maximize benefit from acquisition of the desired substance.

Simple competition between possible, unconscious, response pathways is inadequate when choosing between immediate small rewards (a cigarette right now) and abstaining from gratification to achieve long-term goals (quitting smoking to get healthier). Because desires are conscious, they are the reasons people attribute to their behaviors (Piasecki, Richardson & Smith, 2007). Although the correlation between experienced desire and actual behavior does not prove that the desire caused the behavior, we contend that the conscious experience has

informational content that supports behavioral decision-making. We know that satisfying a desire is an *important* goal because we experience the desire strongly. At a rational level, we know that quitting smoking is more important for us than smoking a cigarette now, but we relapse at least partly because we feel the desire more keenly than we can feel the benefits of quitting. In terms of EI theory, we can imagine smoking and the satisfaction it will give us vividly because we have done it often and recently. In contrast, we struggle to imagine the health benefits that quitting will afford because we have less information and experience on which to base our imagery. With practice, this pattern of goal imagery and priority can be reversed, as in the anorexia example.

We suggest that, in the absence of conscious experience, behavior would be more strongly driven by unconscious reward pathways stimulated by exposure to environmental and physiological cues. Consciousness provides a more level playing field that allows us to compare immediate goals with long-term term goals that have no immediate reward value. In this sense, we share Prinz's view that consciousness is embodied, that it "arises when decision centers gain access to the representations that are especially useful for deciding how to act " (Prinz, 2008, p. 17).

Conclusions

Distinguishing between conscious and unconscious processes and contents has allowed us to define desires as events in time, which can be described on dimensions of duration and frequency as well as by their affective intensity. By doing so, we distinguish felt urges or desires, which are correlated with behavior (e.g. Shiffman et al., 1997), from general neurobiological and physiological states of addiction, hunger, thirst et cetera that predispose behaviors. As in other domains, there is a close correlation between conscious experience (desire) and the operation of effortful, controlled cognitive processes (imagery of desired outcomes). Competition between competing desires and goals operates at least in part at this level of controlled cognitive processing. Desire motivates behavior as a hot cognition with positive affective qualities and negative affective consequences, but is vulnerable to interference because of its heavy dependence on cognitive resources. An accurate distinction between conscious and unconscious processes allows interventions to treat cravings to include targeted psychological as well as pharmacological therapies.

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